Hamilton (F. H.)

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UNION BY ADHESION, IN LARGE INCISED WOUNDS

BY

FRANK H. HAMILTON, M.D.

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THE ART OF PRIMARY UNION, OR UNION BY ADHESION, IN LARGE INCISED WOUNDS.

In the following pages I shall employ the terms "primary union," "union by adhesion," "union by coagulable lymph or by fibrin," and "union by adhesive inflammation" as synonymous, recognizing no other forms of primary union than those which have been thus variously designated by different writers, and of which the last mentioned is, perhaps, the most representative.

The conditions requisite to insure "primary union," or "union by adhesive inflammation," in large incised wounds, are:

First, a good, or at least an average state of the general health, and especially the absence of any systemic infection or dyscrasy, such as pyæmic or septicæmic infection, struma, syphilis, etc.

Second, the removal of all foreign bodies from the wound.

Blood is a foreign body. It must therefore have ceased to flow, and such as remains upon the surface must be carefully removed. It must be rendered certain, also, that it will not again flow after the wound is closed.

Soon after the infliction of the wound, when the bleeding has wholly ceased, serum, a product of the first stage of reaction, begins to be poured out, and in greater or less amount, according to the extent of the surface exposed, and the degree of the reaction. Equally with blood it is a foreign substance. If effused in small quantities, however, it may be absorbed; but if effused in large quantities it will not be absorbed, and will as effectually prevent primary union as the presence of blood;

and since it often continues to flow for three or four days after the wound is closed, it will be necessary, in many cases, to provide for its escape by suitable drainage.

Third, lymph, or as it is also called, coagulable lymph, soon begins to be effused, coincident with the second stage of reaction. If the reaction does not exceed certain bounds it is euplastic, and is the material by which, or through which, primary union is to be established. It coagulates readily, and its presence upon an open wound is usually indicated by the glazed appearance of the surface. It is advantageous, therefore, to leave the wound open until this appearance is presented.

Fourth, in the cleansing, closure, and dressing of the wound every precaution must be taken not to do any unnecessary violence to the parts, either by the hands, the sponges, sutures, adhesive strips or bandages, or at a later day in the renewal of the dressings, since all these things tend to increase the inflammatory reaction, and to carry it beyond the limitations which are assigned to the effusion of euplastic lymph. In short, they precipitate suppuration

The same conditions are requisite for securing primary union in *contused* and *lacerated* wounds as in simple incised; but in consequence of the immediate devitalization of the tissues, resulting in the formation of sloughs, or of the excessive inflammatory reaction occasioned by the violence done to the parts, the portions of these wounds which will be permitted to unite by adhesion will be comparatively small; and in some cases the promise in this direction is not sufficient to warrant the attempt.

The several conditions above named as necessary for the union of large wounds by adhesion are not now for the first time declared. Their first enunciation was made substantially in the latter part of the last century, and were repeated often by systematic writers. They were a part of my earliest lessons in surgery, and have been taught and practised by me during all my profes-

sional life up to the present time. I believe, also, that a strict compliance with these rules constitutes the only grounds for the superior success of some surgeons, as compared with the success of others, at the present day; and if their success is greater than that of surgeons who fifty or one hundred years ago practically applied these rules—and I am willing to concede that it may be, although it is not proven—it is because they have more exactly complied with the conditions named.

In order to place before you satisfactorily my grounds for this belief, it will be necessary to recall, briefly, the history of this department of surgery.

As to the best mode of treating large incised wounds the opinions of surgeons have differed in different periods of the history of surgery. These periods have usually been arranged under two divisions, namely, the earlier period, in which it was taught almost universally that they must be left open, in order that they might unite by granulation; and the later period, dating from the latter part of the last century, in which it has been taught that they should be closed, and encouraged to unite by adhesion.

It will appear, however, that during the latter part of the second period, for one reason or another, the practice, if not the teachings, of surgeons has at times greatly faltered, if it had not at one time, not very remote, gone back fully to the practice of the first period. Surgeons again preferred to leave their large wounds open, to suppurate and close by granulation. Certainly very many practised it, and not a few publicly taught that this was the best method. This lapse of faith has happily been overcome, and confidence in union by adhesion is today completely restored. The probable causes of these fluctuations of opinion will, perhaps incidentally, be made apparent in the following history, although my main purpose is to show that the principles underlying success are the same now as they always were.

The first serious attempts to secure union by adhesion

after large amputations were made by Edward Alanson, of Liverpool, whose book, entitled "Practical Observations on Amputations," was published in 1779. His practice and opinions soon found acceptance with the large majority of surgeons in all parts of the world. They were adopted by Hey, Percy, Lucas, Guthrie, Syme, Liston, and Bennett, in England; by Pirrie in Scotland; by Velpeau, Dubois, Boyer, Dupuytren, Delpech, Richeraud, and Roux, in France, and by most of the German and American surgeons.

In what manner this union was to be accomplished, they have constantly, with more or less minuteness of detail, informed us.

Alanson speaks of the importance of securing every bleeding vessel, of drawing the arteries out with a tenaculum, so that the ligatures shall not include other tissues, and thus form sloughs or delay their removal; of making the flaps so long that they will come together without strain, and of securing proper drainage.

Says Velpeau, speaking of incised wounds in general: "In order to attain this end, we must give to the dressing more care and time than is ordinarily given to it; the section of the soft parts should be neat and regular; the integuments should fall without effort on the front part of the stump." . . . "All the arteries liable to bleed should be immediately tied or twisted; the sides of the wound, freed from foreign substances, should touch throughout their whole surface." . . . "The straps should do no more than preserve the coaptation, without pressing or exercising any drawing force." . . . "The suture should be added to them, or even preferred, if the skin is thin or tends to roll inward; the diseased parts should be afterward kept in the most perfect immobility, and the inflammation should be moderated by every possible means."

When speaking of amputations Velpeau repeats in effect the same instructions.

Most of these surgeons have referred in their writings

to the necessity of waiting until the surface of the wounds becomes *glazed*, before closing them.

"After a time," says Bennett, "the surface is glazed, as it is called;" and it is at this period that he recommends the closure of the wound.

Says Pirrie: "All oozing having been completely arrested, foreign matter removed, and the surface having taken on a glazed appearance," we may proceed to close the wound.

Not a few of the most distinguished operators went much farther both in their teachings and practice.

Mr. Syme says wait six or eight hours before closing the wound.

Velpeau says that "in order to arrive with more certainty at this result, Parrish, in America, and also a great number of surgeons in England and Germany, and Dupuytren, in France, have established a precept not to dress recent wounds but after the lapse of some hours." Dr. Townsend, in a note to the American edition of Velpeau, says that Dr. Valentine Mott "approves very highly of leaving many wounds exposed for some time, even for an hour or more."

Of those mentioned above, Mr. Syme subsequently modified his opinion so much as to permit the dressing to be made at the same time as the amputation.

Even at a date much later than any writer which has been hitherto mentioned, Mr. Erichsen has said, "Hence in the dressing of surgical wounds, such as stumps after amputation, and in all cases in which it is advisable to attempt to procure union by adhesive inflammation, the cut surfaces should not be brought together for a few hours, until all oozing of blood has ceased and the fibrinous layer has been thrown out."

It needs to be said that, following the example of Mr. Syme, after a time most surgeons relinquished the practice of waiting several hours before closing the wound, both because of its inconvenience and because in most cases the glazed appearance was found to be present

sufficiently early to enable them to do so without compromising the desired result.

Alanson, Syme, Liston, and probably all the systematic writers of this period, taught the necessity of not only stopping all bleeding, but also of providing for the escape of serum by suitable drainage. Mr. Syme, in 1825, wrote a paper in which he spoke of the flow of serum as "invariable," and of the absolute necessity, therefore, of providing for its escape.

Let us now inquire what were the results of this plan of treatment, which was substituted for the open treatment, and which found favor with so many—nearly all, indeed—of the most practical surgeons at the close of the last century and up to a late period during the present century.

Alanson declares that, under his improved treatment, of 35 cases of amputation of the leg and thigh, at the public hospital in Liverpool, he did not lose one, while of the preceding 46 amputations he had lost 10.

Mr. Liston, a pupil of Syme's, says, that of the last 20 cases of amputation of the thigh for chronic disease, which he had seen performed by Mr. Syme under this plan of treatment, not one died; and this although some of them seemed in a nearly hopeless condition at the time of the operation.

Of 92 soldiers treated in this manner on the field of battle by Percy, 86 were cured in twenty-six days; and of 70 cases thus treated by Lucas only 5 died.

It is true that Pelletan, who did not favor the practice of attempting union by adhesion, lost 5 out of 6 treated by himself; but it is sufficiently apparent that he had not complied with two of the most important conditions of success, when he declares that in all the fatal cases the autopsy showed the presence of blood, as well as of pus, between the surfaces of the wounds; and that in the only case in which recovery took place the accumulated pus forced off the adhesive straps. He had neither secured the bleeding vessels properly, nor provided for drainage.

What treatment, either ancient or modern, has presented a better record than this furnished by Alanson, Syme, Liston, Percy, Lucas, and, so far as we know, by the faithful disciples and distinguished advocates of their practice?

It is scarcely necessary to remind you that these results were obtained before the introduction of anæsthetics or of antiseptics.

In the face of these remarkable and universally conceded successes, which contrasted so strongly with the slow and uncertain results of the earlier practice, it is hard to understand how any steps backward could have been taken; but this is what actually happened, the retrograde movement commencing even before the distinguished advocates of the new system had died. Here we enter that point in the history of the treatment of wounds to which I have already referred, as that in which the practice of attempting to obtain union by adhesion "faltered," and surgeons were everywhere returning to the practice of leaving their large incised wounds to suppurate and granulate. Of the fact as now stated there is no question. How this change was brought about I will now attempt to explain, and also how, through the agency of one man, Mr. Lister, the practice of union by adhesion was happily restored.

In the first place, to comply with all the conditions demanded for union by adhesion requires time and painstaking. It demands scrupulous attention to the most minute details. To omit one of the many conditions named is, in most cases, as fatal as to omit the whole. Celerity is here inconsistent with success. Surgeons, therefore, who wish to acquire a reputation as "brilliant" operators, are likely, especially in their public or hospital exhibitions, where their example can do most harm, to fall short of the requisition, and then, by their failures, to bring discredit upon the system they teach and are attempting to follow.

Second, war is unfavorable to this department of sur-

gery. The exigences of the battle-field do not supply the time, nor the appliances necessary for the application of all the principles involved in primary union. There are many occasions on the field of battle when the demands upon the surgeon to save the life of the patients temporarily, must be paramount to all other considerations, and in which, as Armand has said, the only precept is, *cite, citissime.*

Macleod says, speaking of his experience in the Crimean War, "I never saw one case among our most numerous amputations in which primary adhesions took place throughout the whole surface of the flaps."

My personal experience in our own late Civil War was that primary union after large amputations was the exception; and that toward the close of the war army surgeons were everywhere returning to the practice of open dressings. This lack of success in their attempts to secure primary union upon the field induced, it is fair to suppose, on the minds of many who did not sufficiently consider the causes of their failures, a general lack of confidence in the plan, which led them to reject it even after they returned to civil practice.

If Percy had better success as an army surgeon in securing primary union than most other surgeons have had, it was because he was better able to comply with the conditions.

Third, the introduction of anæsthetics has had no inconsiderable influence. My own experience has not furnished me with any evidence that general anæsthesia has appreciably delayed the union of tegumentary wounds, or of the majority of small wounds, when they occur in most of the other tissues of the body. What the fact may be in this regard, I am unable to say, nor would it perhaps be very easy to determine; but in reference to its effect in large muscular wounds, or in major amputations, and especially where muscular flaps are made, I have no doubt their union has been thereby delayed and often prevented.

I practised surgery some years before the introduction of anæsthetics, and soon after I began to use them it became a matter of common observation with me, and of comment, that the same measures did not so often insure primary union as before. I think also that Macleod's experience in the Crimean War, already referred to, goes further than proving that amputations made under these circumstances do not usually comply with the conditions of success. He says that "chloroform was almost universally used in the British army." If, then, he was unable to meet with a single case of complete primary union, it seems fair to charge a part of this result to the general use of chloroform.

But aside of any specific testimony upon this subject, let me appeal to the reader's intelligent judgment. When large flap amputations are made while the patient is completely under the influence of an anæsthetic, in addition to the total loss of sensibility—for which both operator and patient have reason to be thankful—we observe that the muscles do not quiver and retract under the knife, that they hang apparently lifeless from the wound as they do when made upon the cadaver, and that they do not wholly resume their normal contractility and position until some hours after the operation is completed. The arterial blood is dark, and can scarcely be distinguished from the venous, showing that it is imperfectly oxidized. The surface of the wound has a dark, grumous look, wholly unlike the appearance presented under other circumstances.

Is it reasonable to suppose that the effusion of lymph, so as to give a glazed appearance to the wound, and which is essential to primary union, will not, under these circumstances, be delayed? and that this delay will not often extend beyond the period when primary union is possible? For myself, if I were asked this question, and no evidence were presented on either side, I would say it must necessarily be delayed.

I have been speaking thus far of the circumstances

which seem to explain why surgeons for a while faltered in their faith in primary union. This explanation, however, which may or may not be correct, was not necessary to the historical sketch which I proposed to make. The material point is, that for a time surgeons did actually treat wounds as if they had forgotten the conditions of success, or had lost faith in the earlier teachings.

In attestation we have only need to recall what we have often witnessed in the public amphitheatres in this city and elsewhere during the last twenty or thirty years; large flap amputations, made dexterously, but afterward the surfaces of the wound rudely handled, fretted by rough sponges, the wounds closed before the blood had ceased to flow, then hermetically sealed by adhesive straps, without provision for drainage, and hurried from the amphitheatre to make way for another brilliant operation.

To one who has only observed the results of this method of treatment, without having given attention to the means by which they were brought about, the sole conclusion must be, that it would be far better to return to the old practice of leaving the wounds open, since nothing short of a miracle could secure primary union; and this is precisely the conclusion to which, within a few years, some surgeons have arrived.

We have now reached the period in the history of surgery when Mr. Lister interposed, and turned back the tide. He taught that under a most thorough system of antisepsis primary union could be secured; and he demonstrated that it could be secured even after the most profound anæsthesia. This was the great lesson which he had in his mind, and which he successfully taught; but he taught also, incidentally, that the wound must be handled gently, all foreign substances must be removed, the blood must cease to flow, and provision must be made for drainage. In short, if you will look carefully into his teachings and practice, and the practice of his disciples, you will see that they omit nothing

which, in the opening of this paper, I declared essential to success; and I venture to say, that if they did, no amount or quality of antisepsis would secure union by adhesion.

The influence of Mr. Lister, backed by his specious theories, secured a return to the old practice of the advocates of primary union in all its essential details, and to this it added antisepsis. Fortunately, antisepsis carried with itself, inseparably, one thing more, namely, the agency of a moderate stimulant and astringent, which served materially to resuscitate the tissues and the capillary vessels which had been temporarily paralyzed by the general anæsthesia, and thus in some measure to counteract its deleterious effects.

As to his practice of removing carefully and effectually all foreign substances before closing the wound, and providing for the escape of the serum or blood which might subsequently be effused between the cut surfaces; and as to his practice of applying industriously, so long as the wound was open, a moderate stimulus to the cut surfaces in the form of spray or lavements of dilute carbolic acid—these are *facts* which admit of no dispute. But as to his declaration that the results which he obtained were due to the destruction of certain micro-organisms constantly floating in the atmosphere, and which being received and propagated upon the raw surfaces prevent primary union, or which being conveyed into the system by absorption cause septicæmia—this is only a *theory*, and one which is far from being universally accepted. It has not been conclusively shown that the formation of pus depends in any case upon the presence of germs. When suppuration takes place in closed cavities these germs are generally absent; but as if to show how impossible it is to prevent their pernicious intrusion—in case it be admitted that they can or do cause suppuration—they are occasionally found in great numbers in cavities which have never been open to the air.

If germs are so readily absorbed by open surfaces, and distributed through the system, of what possible use is it to commence the application of the antiseptics one or several hours after the reception of a wound, or months after the skin has been destroyed, and then apply it with so much assiduity, so long as the knife of the surgeon or his hands are in the wound?

If, on the other hand, the germs are not so easily absorbed, and only nestle upon the surface of the wound, why, instead of using the antiseptic from the beginning to the close of a surgical operation, is it not sufficient to apply it thoroughly just before closing the wound?

There is one quality or property of antiseptics to which allusion has not yet been made, namely, their power to prevent the decomposition of blood, of pus, and of serum; the decomposition of either of which changes these otherwise comparatively innocuous fluids into an irritating ichor. But when employed for this purpose they can serve no useful end, except when blood. serum, or pus are actually present. To apply them, therefore, immediately preceding the closure of the wound, and whenever subsequently blood, serum, or pus present themselves, or seem likely to present themselves, is rational, and would justify their employment also, within certain limitations, in all cases, after the closure of the wound and until the end of the treatment; but it supplies no argument for the adoption of all the complicated procedures with which Mr. Lister and his disciples preface and encumber their operations.

The conclusion to which we are brought is, that while we are indebted to Mr. Lister for having restored confidence in union by adhesion, it seems equally certain that his excellent results have been obtained, not by a literal compliance with the rules which are the logical deduction from his theories, but by his strict enforcement, in the practical application of his theories, of certain other conditions, which he seems to regard as accessory and incidental, rather than of paramount importance.

If this conclusion is correct, then there is not sufficient reason why the air of a room in a private house, or even in a public hospital, not suspected of being infected by some contagious or infectious disease, such as diphtheria, scarlatina, erysipelas, etc., should be disinfected before an operation is performed, or why all persons present should have been previously disinfected, or that they should be required to breathe through disinfecting respirators, or should wash their hands in carbolized water, or search beneath their nails for concealed germs, or why they should carbolize their instruments, or why, indeed, they should pour a constant stream of carbolized water or of spray upon the wound while operating, except, as I have already stated, for its utility in closing the capillary vessels, and its power in restoring tone to the paralyzed tissues when anæsthetics have been employed.

The various manipulations and devices for the purpose of excluding the germs above enumerated have at one time or another been suggested by Mr. Lister or his disciples, and, in my opinion, they are all necessary if Mr. Lister's theory be correct. If it be not correct, they serve no other purpose than do the walking, talking, and gestures of the prestidigitator. They abstract the attention, and conceal the adroit manipulation by which the trick is actually performed.

I say this with all respect for the integrity of the distinguished surgeons who hold strictly to Mr. Lister's opinion and practices, since in one particular they differ from the class to which I have compared them. The prestidigitators are not deceived, but deceive their audiences; while Mr. Lister and his disciples deceive both themselves and their audiences.

It will be observed that I have thus far spoken only of carbolic acid as an antiseptic, since it is that which was first used by Mr. Lister, and still continues to be more commonly used than any other; but I am aware that surgeons have lately substituted many other things for carbolic acid, and with equally satisfactory results; and that many who

continue to prefer carbolic acid have rejected the continuous spraying, and in several other particulars have modified the treatment. At the present moment a weak solution of the bichloride of mercury is the most active contestant of the alleged superior virtues of carbolic acid.

In a paper read before the New York County Medical Association in February, 1885, Dr. Theodore R. Varick, surgeon to St. Francis' Hospital, Newark, N. J., states that he has for nearly six years substituted hot water, or water a little below the boiling-point. Immediately after the larger vessels have been tied, he applies the water freely and continuously to the raw surfaces until all oozing has ceased and "the parts are thoroughly glazed." The effect of this is, as claimed by Dr. Varick, to coagulate the albumin in the serum, by means of which the open vessels are closed against the admission of germs, and to impart a moderate stimulation.

In a private letter Dr. Varick informs me that of thirty-nine major amputations thus treated, mostly in cases of railroad accidents, only two terminated fatally, one by hemorrhage and one by cardiac disease; and that in all of the various operations performed by him there has been no case of septicæmia or of pyæmia, "although in several instances the hygienic surroundings have been of the worst kind."

Dr. Varick attributes his remarkable success, which is probably equal to that obtained by those who adhere to the use of carbolic acid, or of the bichloride of mercury, to the power of hot water to close hermetically the capillaries, and thus to prevent the admission of germs. Since, however, in most of his cases—railroad injuries—there must have been extensive exposure of the vessels by laceration, it is again difficult to understand, as I have before suggested, how they can be excluded when the door has been left open for some hours before the patients came under his notice. In short, while I fully approve his practice, and have myself often adopted it, I do not accept his theory.

Mr. Lawson Tait, in reporting "a series of one hundred and twelve consecutive cases of consecutive operations for ovarian and parovarian cystoma without a death," and in which no antiseptics were employed, says: "I tried the so-called antiseptic system in all its ever-varying details in as complete and unprejudiced a series of experiments as I believe it possible for man to undertake." . . . "I finally came to the conclusion that my patients were being poisoned by the use of carbolic acid, thymol, and various other substances, which were being used by others as well as myself for the purpose of destroying the germs which were supposed to do so much harm," . . . and he adds, that his experience had proven to his own satisfaction conclusively that he "could do better without Listerism than with it; that, in fact, the only tendency of this so-called antiseptic system was to mar" his success.

In the light of all that has already been said upon this subject no one familiar with Mr. Tait's careful and painstaking mode of operating, will fail to see where lies the real secret of his hitherto unparalleled success, and which he himself says is due to "increased personal experience, increased attention to all the minute details which go to create success, and inattention to any one of which may defeat the best-laid plans." "In every case," he adds, "where there has been a tendency to ooze, or where the patient has been advanced in life, I have used the drainage-tube, an addition to our means of saving life of which it is impossible to speak too highly."

I agree fully with Mr. Tait, that this simple narrative of his personal experience, the accuracy of which is assured by his acknowledged integrity, and by abundant collateral testimony, ought to "dispose forever of the much-discussed question of Listerism in abdominal surgery"

Incidentally I will add that it ought to furnish a beam of light to those surgeons who, during the last three or four years—ever since the death of President Garfield—have been prophesying the brilliant future of gunshot

wounds of the belly under a "strictly antiseptic treatment," according to whom the time was near, if it had not actually arrived, when, under the protective influence of antisepsis, surgeons would open the belly freely, unravel the intestines and close their wounds, search carefully through every pocket of the peritoneal cavity, and, if need be, dissect and explore the regions outside of the peritoneum, and, having found and removed the lost ball, they would wash out the fecal matter and the blood which had necessarily escaped into the peritoneal cavity, and close the abdominal wounds, with a reasonable probability of restoring the patient to life and health. The fact that the vertebræ had been penetrated and were crumbling would constitute no bar to success; and indeed nothing would interpose a serious obstacle, except that the missile had lacerated some important blood vessel, or had buried itself in some solid viscus, a fact which perhaps nothing but an ante-mortem or post-mortem dissection could determine.

These inspired revelations, uttered sometimes with a certain tone of regret for the lamentable ignorance of those who have lived before them—generally by men who have had little or no personal experience in the treatment of such wounds, and who certainly never practised successfully what they foresaw in their prophetic vision—still wait for fulfilment, notwithstanding the many thousand opportunities which both civil and military experience have since furnished.

I am not prepared to say that surgeons have not exaggerated sometimes the dangers and difficulties of searching for balls which have entered the cavity of the belly; but I do not think so; and I believe that all surgeons who have had much experience in this class of injuries will agree with me. I only intend to say that antisepsis has in no degree abated these dangers and difficulties.

Before dismissing this subject it seems necessary to consider briefly certain relatively modern suggestions, other

than antisepsis, which have been made for the purpose of securing the primary union of large incised wounds.

"Bruising" the vessels, first suggested by M. Briot, and "torsion," which owes its introduction to M. Velpeau, are both still practised upon the small vessels with a certain degree of success, but in my personal experience both have more often failed.

Veitch, in 1806, used for the ligation of both large and small vessels very fine silk, and cut off the ends, leaving the knot in the wound to become encysted; but as small abscesses subsequently formed in many cases, Ruysch, of Germany, and Physic, of this country, substituted animal ligatures, and treated them in the same manner. Valentine Mott says, like the silk ligatures they often formed abscesses, and after a short time their use was almost entirely abandoned.

At the present time we see the practice of using the animal ligature revived, but only, for the most part, in its application to small vessels upon the surface of the wound. In this manner they are now used quite freely, and no doubt serve the purpose of shortening the period we may have to wait before closing the wound, and of giving additional security against secondary hemorrhage during the early period of reaction. Notwithstanding the statements made to me by some surgeons, that they have seen no abscesses follow their use, this has not been my experience. In at least two cases out of the few in which I have adopted this practice very small abscesses have formed. I must, therefore, consider the method as still under trial.

The substitution of cloth or a towel for the sponge, as a means of removing the blood from the surface of the wound, made, as I understand, for the purpose of protecting the patient against septic germs, is subject to the criticism that it is illogical. If germs can be destroyed which lie exposed upon the surface of a wound, or upon instruments, they can equally be destroyed when they lie secreted in sponges, by a thorough saturation with some

disinfectant, or by boiling water; and if they cannot be so disinfected, neither can the towel be. I observe, however, that in using the towel it is only laid upon the surface, not drawn roughly over it, and in this practice I see a positive gain. When a sponge is drawn roughly over the quick and sensitive wound, in the case of a patient who is not anæsthetized, it causes most acute pain; and although when the patient is insensible it can no longer cause pain, it can fret and partially disintegrate the surface as when rasped by a file. If surgeons' assistants cannot learn how properly to use a sponge, let them use a towel.

Drainage-tubes made of bone, from which the mineral structure has been removed, and which, therefore, may become dissolved or even absorbed, present no possible advantage over the ordinary india-rubber flexible tube, except that, if by any accident they should escape into the wound, they will take care of themselves and probably do no harm. The objection to them is, that they are short and inflexible, and cannot be made to follow a long and tortuous canal.

In closing the wound some modern surgeons have given the preference to metallic sutures, others to the animal sutures, or to horsehair, for each of which it is claimed that they cause less irritation than silk, and in this way improve the chances of primary union.

Any suture, no matter of what material composed, will cause irritation and suppuration at the points of pressure, if it is employed upon tegumentary tissues for the purpose of drawing the lips of the wound together forcibly, as when, owing to a deficiency of structure, they could not otherwise be made to meet; but I have elsewhere explained that this is not, in tegumentary wounds, and but rarely in any wound, the proper function of a suture.

In the class of cases now under consideration, where we desire prompt primary union, the suture is intended only to place the edges of the wound in accurate apposition, and to prevent inversion. For this purpose the

finest silk suture, introduced as near the margin of the wound as possible, and tied lightly, is the best. It will cause no more irritation than the wire or horsehair, is much more flexible and adjustable, and is, therefore, much more easily and painlessly introduced and removed. The accuracy of these statements I have frequently verified by employing the two materials on different parts of the same wound.

The value of the animal suture consists solely in its being spontaneously removed. If it be claimed that its value, as now generally employed, consists in its being carbolized, the reply is, that the silk may be treated in the same way. The only objection which I have to its use is, that it is less flexible that silk and is not so fine as the finest silk.

Hot water, as a means of imparting a healthy stimulus to paralyzed tissues, of arresting capillary hemorrhage, and of removing the blood from the surface of the wound, has long been employed by me, applied by means of a sponge. The suggestion of Dr. Varick, to apply it in an interrupted stream from the nozzle of a pipe connected with a reservoir, in the same manner in which the antiseptic solutions are now often employed, commends itself theoretically and by its results. A current of hot water, falling with moderate force upon the wound, not only removes the blood from the surface, but also washes it from the tissues where it has accumulated around the bleeding orifices of the small vessels, exposes them to view, and enables the surgeon to apply a ligature if required. It also coagulates the albumin, and for this reason, if for no other, it ought to be satisfactory to those who believe that by the interposition of this shield the vessels are protected from the intrusion of germs; while it is absolutely innocuous, a quality which is not possessed by any of the antiseptics, so called, now in use. The occasional toxic effects of carbolic acid and of the bichloride of mercury, in their surgical application, are known and admitted by all the advocates of antisepsis.

Dr. Varick recommends that the water have a temperature "slightly below the boiling-point." This might do if one were to apply it by means of a sponge, and then only for an instant, as I have often done to close a bleeding arteriole; but if employed continuously, or by irrigation, through the nozzle of a tube, it ought not to exceed in temperature 112° or 115° Fahrenheit, or the temperature which may be easily borne by the naked hand.

Finally, I wish to say that while it seems to me capable of demonstration that the real secret of Mr. Lister has lain concealed under a series of complicated manipulations, my confidence in the intelligence of my professional brethren is such that I believe they will soon abandon all those procedures which are irrelevant and wholly unnecessary to success. This is what they have already begun to do. In addition to those whose names I have mentioned, Mr. Keith, Mr. Callender, Mr. Savory, and Mr. Bryant, have publicly declared their non-acceptance of the doctrines of Mr. Lister, as have also a considerable number of equally distinguished French and German surgeons; and the number of those who have, after a fair trial, substantially ceased to practise them according to his theory, is constantly increasing. Let us take care, however, that in severing our attachment to certain theories and practices, we do not loose our hold upon anything, whether new or old, which is really useful.

Antiseptics have their position and function in a great variety of wounds, including large simple incised wounds, under certain circumstances, and at certain stages of their progress. What this position is in the latter class of cases—whether it be dominant or subordinate—I have sought to explain.